

Appl. No. 10/726,987

Reply to Office action of 04/20/2005

**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of Claims:**

1. (previously presented) A method for manufacturing a semiconductor device, comprising:

depositing a dielectric layer on a substrate, the dielectric layer having a dielectric constant greater than the dielectric constant of silicon dioxide;

subjecting the dielectric layer to a plasma, the plasma operable to reduce top surface roughness in the dielectric layer; and

annealing the dielectric layer before subjecting the dielectric layer to the plasma.

2. (Cancelled)

3. (previously presented) A method for manufacturing a semiconductor device, comprising:

depositing a dielectric layer on a substrate, the dielectric layer having a dielectric constant greater than the dielectric constant of silicon dioxide;

subjecting the dielectric layer to a plasma, the plasma operable to reduce top surface roughness in the dielectric layer; and

annealing the dielectric layer after subjecting the dielectric layer to the plasma.

4. (Rejoined) The method of Claim 1 where the resulting high-k comprises hafnium silicon oxy-nitride.

5. (Original) The method of Claim 1, wherein the dielectric layer comprises hafnium silicon oxide.

6. (Rejoined) The method of Claim 1, wherein the dielectric layer comprises hafnium oxide.

7. (Currently Amended) A method for manufacturing a semiconductor device, comprising:

Appl. No. 10/726,987  
Reply to Office action of 04/20/2005

depositing a dielectric layer on a substrate, the dielectric layer having a dielectric constant greater than the dielectric constant of silicon dioxide;

subjecting the dielectric layer to a plasma, the plasma operable to reduce top surface roughness in the dielectric layer, wherein the dielectric layer comprises a hafnium aluminum oxide.

8. (Rejoined) The method of Claim 1, wherein the dielectric layer comprises an oxide from the group of lanthanum oxide, gadolinium oxide, tantalum oxide, yttrium oxide, titanium oxide, chromium oxide, aluminum oxide, and zirconium oxide.

9. (previously presented) A method for manufacturing a semiconductor device, comprising:

depositing a dielectric layer on a substrate, the dielectric layer having a dielectric constant greater than the dielectric constant of silicon dioxide;

subjecting the dielectric layer to a plasma, the plasma operable to reduce top surface roughness in the dielectric layer, wherein the dielectric layer comprises a ternary transition metal oxide from the group of ZrHfO, TaTiO, ZrTiO, HfNbO, HfVO, ZrVO, TaNbO, TaVO, TaNbO, HfTiO, and HfTaO.

10. (Original) The method of Claim 1, wherein the dielectric layer comprises a ternary oxide.

11. (Original) The method of Claim 1, wherein the dielectric layer has a dielectric constant greater than 3.9.

12. (Original) The method of Claim 1, wherein depositing a dielectric layer on a substrate comprises chemical vapor deposition.

13. (Original) The method of Claim 1, wherein depositing a dielectric layer on a substrate comprises atomic layer deposition.

14. (Original) The method of Claim 1, wherein depositing a dielectric layer on a substrate comprises physical vapor deposition.

15. (Original) The method of Claim 1, wherein the plasma is an argon plasma.

Appl. No. 10/726,987

Reply to Office action of 04/20/2005

16. (Original) The method of Claim 1, wherein the plasma is a xenon plasma.
17. (Original) The method of Claim 1, wherein the plasma is a krypton plasma.
18. (Original) The method of Claim 1, wherein the plasma is an oxygen plasma.
19. (previously presented) A method for manufacturing a semiconductor device, comprising:  
  
depositing a dielectric layer on a substrate, the dielectric layer having a dielectric constant greater than the dielectric constant of silicon dioxide;  
  
subjecting the dielectric layer to a plasma, the plasma operable to reduce top surface roughness in the dielectric layer, wherein the plasma is a nitrogen plasma, the nitrogen plasma further operable to incorporate nitrogen into the dielectric layer.
20. (Original) The method of Claim 1, wherein the plasma is a helium plasma.
21. (Original) The method of Claim 1, wherein the plasma is a combination of any plasmas from the group of plasmas including argon, xenon, krypton, oxygen, nitrogen, and helium.
22. (previously presented) The method of Claim 1, wherein annealing the dielectric layer further comprises using an inert plasma.
23. (previously presented) The method of Claim 1, wherein annealing the dielectric layer further comprises heating the dielectric layer to remove impurities.
24. (Original) The method of Claim 3, wherein annealing the dielectric layer further comprises subjecting the dielectric layer to a nitrogen plasma, the nitrogen plasma operable to incorporate nitrogen into the dielectric layer.
25. (Original) The method of Claim 1, wherein the plasma comprises a dual-frequency plasma.

Claims 26-31 (Cancelled).